Issues for Beryllium Surface Contamination Control

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Dr. Mark D. Hoover
Lovelace Respiratory Research Institute
Albuquerque, New Mexico

Surface Contamination Issues

- Purpose of contamination control
- Technical basis for the historical limit
- Procedural issues:
  - Wet versus dry techniques
  - Composition of the dust layer
  - Type and texture of the surface
  - Removable versus estimated total
  - “Disruptability” of the surface
  - Amount of surface
  - Where and how many samples to take

Contamination Control Should:

- Minimize exposures from dispersed dusts
- Prevent dispersion of dusts to other areas
- Allow early detection of leaks
- Provide an overall indicator of operational control

Basis for the Historical Guidance of 25 μg/ft^2

- No record exists regarding the technical basis for the recommendation
- Was established as guidance by the AEC in the late 1940s or early 1950s
- Was not a regulatory requirement
- Was considered "an appropriate level of cleanliness for areas where people work, and for release of beryllium-containing items for public use"

Calculated Air concentration above a surface contaminated at a level of 25 µg/ft^2 (2.7 µg/100 cm^2) for a range of resuspension factor values

Assumed Resuspension Factor	Expected Air Concentration (µg/m^3)
10^{-4}	0.03 µg/m^3
10^{-5}	0.003 µg/m^3
10^{-6}	0.0003 µg/m^3
10^{-7}	0.00003 µg/m^3
10^{-8}	0.000003 µg/m^3

The resuspension factor is defined as the ratio of the µg/m^3 air concentration that results from a surface contamination of a given µg/m^2.

Uncertainties
the Resuspension Ratio Calculations

- Typical experimental data come from large areas of uniform contamination
  - This makes the risk estimate conservative for small surface areas
- Most data are from outdoor situations
  - Ambient levels of surface nuisance dusts are lower in the workplace
- Modifying factors such as surface type and degree of disruption are poorly characterized

Comments on the Historical Guidance

- May be considered somewhat arbitrary
- Appears generally adequate for the workplace
- Should be accompanied by As Low As Practicable approaches
- Should be accompanied by lower values are advisable for release of equipment or materials to uncontrolled areas
- Provides a simplistic approach to controlling resuspension risks

Wet versus Dry Techniques

- Wet techniques generally remove more material
- Dry swiping is sometimes required to protect parts or to allow counting of swipes for radioactivity

  - Drying of swipes for radioactivity counting may be feasible. But, issues include chain of custody, time, cost, and cross contamination.
- Wet/dry efficiency ratios are poorly characterized

  - Do we need to invest in a better understanding?

Composition of the Dust Layer

- Van der Waals forces are effective, and substantial energy is required to dislodge respirable particles
- Spraying of large droplets or movement of large particles across surfaces can knock small particles into the air by “saltation”
- Oily, wet, or sticky layers are less easily dispersed
  - Should this trigger different control levels?

Type and Texture of the Surface

- Quantitative sampling from smooth stainless steel or glass surfaces is more likely than from rough or textured surfaces
- However, resuspension from textured surfaces is probably less likely than from smooth surfaces
- “Perhaps” the efficiencies and risks are balanced
  - Do we need to know more?

Removable versus Estimated Total

- The presence of removable contamination is generally considered to be a measure of concern for dispersion of the remaining contamination
- Is the estimated total a better metric for rough surfaces?
- Are there any circumstances under which estimated total should be used for control?

Considerations for "Disruptability" of the Surface

- Accessibility to mechanical, pneumatic, or human activity
- Frequency and intensity of disruption
- Degree of administrative or engineered control (Is unexpected disruption possible?)
- Resuspension rates in response to direct disruption
- Resuspension rates in the absence of direct disruption

“Disruptability” (continued)

- Contamination on less “disruptable” surfaces may be monitored but not decontaminated as frequently or extensively as contamination on more frequently disturbed surfaces
- For example, floors may be a major concern, but light fixtures may only require cleaning before maintenance

Amount of surface

- A concept of total resuspension risk may depend on the amount of surface, as well as the contamination per unit area
- Larger items may warrant more extensive cleaning than smaller items
- However, no simple algorithms exist for making such determinations

Where and How Many Samples to Take

- A combination of random and biased sampling seems prudent
- Random sampling can identify unexpected releases
- Biased sampling can provide defensible control charts for known areas of concern
- Reswiping of areas can provide a better estimate of “new” releases
- Are swipe sample results always expected to be log-normally distributed?

Where and How Many (continued)

- The location and number of samples may change with the amount and the distribution of contamination being reported
  - Fewer samples when performance is “good”
- The sampling strategy should support a mitigation strategy for:
  - Decontamination
  - Identification of leaks
  - Improvement in work practices

Conclusion

- A “reasonable” set of contamination control limits should be adequate to protect workers and the public
- Workplace experience should continue to be evaluated to improve work practices
- Cases where resuspension is believed to have caused CBD should be analyzed and documented to clarify the estimated amounts, dispersion, composition, and particle size distribution of the surface contamination

Conclusion (continued)

- Some controlled experiments in the workplace and laboratory should be conducted to improve our technical basis for contamination control
- These activities would provide confidence that contamination control strategies are adequate